SCOTTISH HOME AND HEALTH DEPARTMENT
SCOTTISH HEALTH SERVICES COUNCIL

RHEUMATIC FEVER IN SCOTLAND

Report of a Sub-Committee of the Standing Medical Advisory Committee

EDINBURGH
HER MAJESTY'S STATIONERY OFFICE
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Miss M. J. YEATS (*Secretary*)

REMIT

"To consider the problem of rheumatic fever and rheumatic heart disease in Scotland with particular reference to the incidence of these diseases and the means of prevention."

RHEUMATIC FEVER IN SCOTLAND

Introduction

Appointment and Terms of Reference

1. We were appointed by the Standing Medical Advisory Committee at a meeting on 26th April, 1962. We had 13 meetings. Our remit was:

"To consider the problem of rheumatic fever and rheumatic heart disease in Scotland with particular reference to the incidence of these diseases and the means of prevention."

Magnitude of The Problem

2. To get the probable number of cases of rheumatic heart disease in young adults we took as a basis the figures given by Parkinson (1945 — Harveian Oration). He referred to the number of cases of rheumatic heart disease found in 1942 to 1945 among recruits rejected for military service and said —

> ". . . Through the courtesy of the Ministry of Labour and Dr L. M. Ladell, I have some new figures about recruits rejected for military service by medical boards, those placed in grades III and IV. To the end of August, 1945, about a million were so rejected in England and Wales. In a sample of 30,000 consecutive rejections taken from the whole of England and Wales in 1942, 9% were rejected because they had heart disease. It follows that no fewer than 90,000 men between the ages of 18 and 41 have heart disease. The population of England and Wales (over 40 million) related to that of Scotland with Northern Ireland (over 6 million) would permit a conservative addition of 10,000 such men for Scotland and Northern Ireland. Taking the whole of Great Britain, therefore, we may assume that there are at present 100,000. To these may be added a like number of women for they are affected in slightly greater proportion. I estimate that there are at least 200,000 persons between the ages of 18 and 41 in Great Britain with heart disease, mostly rheumatic, at the present time . . ."

Using these figures and assuming equal prevalence in Scotland and in England and Wales we get a rough assessment on a population basis of 20,000 cases in Scotland at that time, i.e. 1942 to 1945.

Statistics

3. We considered statistics of mortality as provided by the Registrar-General for Scotland in his annual reports, statistics obtained from the Registrar-General in England and Wales and in certain selected countries. We also had before us information obtained from the Scottish Hospitals In-Patient Statistics relevant to the analyses of the discharge of patients from hospitals. Some statistical information from the mass miniature radiography centres was examined. Additionally we considered school health statistics for selected years. We took account of the information obtained in England and Wales from the Annual Report of the Chief Medical Officer of the Ministry of Health in 12 selected areas under the Acute Rheumatism (Amendment) Regulations 1959 (S.I. 1959 No. 213).

Enquiries

4. We invited the views of Dr J. A. D. Anderson of the Rheumatic Diseases Unit, Northern General Hospital, Edinburgh, on incidence. We sought help from Dr J. H. Wright of the Cardiology Department of the Royal Infirmary, Glasgow; and were greatly assisted by Dr T. D. V. Lawrie as well as Dr A. S. Rogen, Dr R. Fife, Dr H. R. L. Fraser and Dr R. S. Walker, cardiologists of the Western Regional Hospital Board, and by Dr K. G. Lowe, Dr D. Emslie-Smith and Dr H. Watson of the Eastern Regional Hospital Board. We obtained, in writing, the views of the Medical Director, Dr T. J. R. Miller of the Mass Radiography Centre in Glasgow on the value of statistics available from his Centre. The Medical Officers of Health for Dundee, Angus and Lanarkshire, namely Dr I. B. L. Weir, Dr J. Macfarlane Thomson and Dr I. C. Monro and members of their staff particularly Dr N. S. Lesslie and Dr D. MacLeod gave us much help.

Investigation

5. We decided that, in order to discover the incidence of rheumatic fever and rheumatic heart disease, a sample survey should be carried out. We agreed that a convenient group to be surveyed would be school children at the last general examination before leaving school (i.e. age 13); the areas we selected were Lanarkshire, Dundee and Angus to represent urban and rural areas in Western and Eastern Scotland. We invited the Medical Officers of Health for Dundee, Angus and Lanarkshire to assist.

Prevalence as indicated by Mortality and Morbidity Data

Mortality Data

6. The data presented in Table 1 show that the number of deaths recorded from rheumatic fever has decreased from 45 in 1953 to 6 in 1963 in Scotland, while in England deaths have gone down from 310 in 1953 to 97 in 1963. This represents reductions in the rate per 100,000 of the population from 0.9 in 1953 to 0.1 in 1963 in Scotland and from 0.7 to 0.2 in England over the same period.

7. The Table also shows that chronic rheumatic heart disease accounted in Scotland for 807 deaths in 1953 and 755 deaths in 1963. Comparable figures for England are 8,837 in 1953 and 6,924 in 1963. These figures, given as rates per 100,000 of the population, reveal a reduction from 15 in 1953 to 14 in 1963 in Scotland and from 20 to 15 in England over the same period.

8. However, when deaths from rheumatic fever are recorded in age groups it will be seen that there has been a striking reduction in the number of deaths from the disease in the younger age groups. Similarly the deaths from chronic rheumatic heart disease are greatly reduced up to age 45 with a general shift towards the older age groups. It may be noted that there is a much higher number of deaths among females than among males which is not reflected in the sex incidence of acute rheumatic fever. The data are presented graphically in Figure 1.

TABLE I

Rheumatic Fever and Chronic Rheumatic Heart Disease
Deaths by Sex and Age 1953 and 1963

Scotland — Annual Report of the Registrar-General for Scotland 1953 and 1963

	All ages		–1		1–		5–		15–		25–		45–		65–		75 and over	
	Male	F'male	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1953																		
Rheumatic Fever	23	22	—	—	—	2	4	6	10	6	5	4	3	1	1	1	—	2
Chronic Rheumatic Heart Disease	274	533	—	—	—	—	8	5	14	21	73	138	106	205	44	89	29	75
1963																		
Rheumatic Fever	3	3	—	—	—	—	—	—	1	1	—	—	—	—	1	2	1	—
Chronic Rheumatic Heart Disease	226	529	—	—	—	—	—	—	4	6	37	73	112	232	41	139	32	79

England — The Registrar-General's Statistical Review 1953 and 1963

	All ages		–1		1–		5–		15–		25–		45–		65–		75 and over	
	Male	F'male	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1953																		
Rheumatic Fever	143	167	1	—	6	3	33	39	19	28	34	41	29	21	17	8	4	7
Chronic Rheumatic Heart Disease	3334	5503	—	—	—	—	22	15	82	90	611	1003	1370	2136	759	1205	490	1054
1963																		
Rheumatic Fever	52	45	1	—	1	1	11	3	7	2	7	5	19	13	4	9	2	12
Chronic Rheumatic Heart Disease	2382	4542	1	—	1	1	2	—	43	28	399	514	1130	1960	491	1096	315	943

Rheumatic Fever and Chronic Rheumatic Heart Disease

Scotland: Deaths by Age, 1953 and 1963

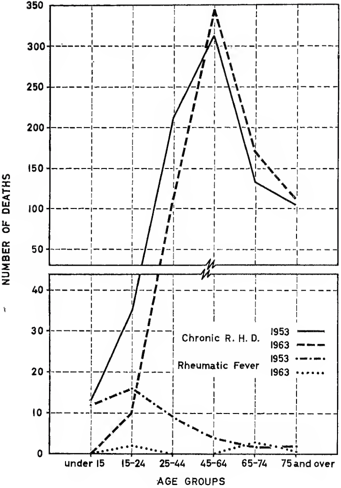

FIGURE 1

9. In Table 2 are shown the deaths by sex from rheumatic fever in Scotland and in England in each of the years from 1953 to 1963. Rates per 100,000 of the population show the comparable decreases which have occurred during this period.

TABLE 2

Rheumatic Fever — Deaths by Sex 1953-1963

Scotland — Annual Report of the Registrar-General for Scotland 1953-1963

	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Males	23	20	27	29	26	7	9	6	4	4	3
Females	22	29	27	19	19	10	12	11	6	7	3
TOTALS	45	49	54	48	45	17	21	17	10	11	6
RATE PER 100,000	0.9	1.0	1.1	1.0	0.9	0.3	0.4	0.3	0.2	0.2	0.1

England — The Registrar-General's Statistical Review 1953-1963

	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Males	143	152	103	102	78	70	63	61	56	62	52
Females	167	147	114	106	96	61	63	64	47	44	45
TOTALS	310	299	217	208	174	131	126	125	103	106	97
RATE PER 100,000	0.7	0.7	0.5	0.5	0.4	0.3	0.3	0.3	0.2	0.2	0.2

10. Table 3 illustrates the downward trend in the deaths from cardiovascular diseases (excluding congenital malformations) in persons under 35 years of age during recent years in a number of developed countries.

11. Table 4 shows that Scotland had a death rate from rheumatic fever of 0.2 per hundred thousand population in 1962, which was the same as for England and Wales and both compared favourably with a number of other countries. On the other hand the death rate of 14.6 per hundred thousand in Scotland from chronic rheumatic heart disease compared less favourably with these same countries.

TABLE 3

Deaths from Cardiovascular Diseases in Persons aged less than 35 years in some developed countries

Annual Epidemiological and Vital Statistics 1952, 1961 and 1962 (World Health Organisation (1955, 1964 and 1965))

Country	Deaths due to Cardiovascular diseases (excluding congenital malformations)						Deaths recorded as due to rheumatic fever or chronic rheumatic heart disease expressed as percentage of all deaths from cardiovascular disease		
	As percentage of all cases			Death rate per 1,000 living					
	1952	1961	1962	1952	1961	1962	1952	1961	1962
Scotland . . .	5.8	4.2	4.0	0.13	0.07	0.07	47.7	36.8	27.9
England and Wales .	5.1	3.9	3.9	0.09	0.06	0.06	52.6	29.1	26.9
Northern Ireland . .	5.5	3.7	3.8	0.13	0.07	0.06	47.6	24.1	40.4
Eire	5.0	3.8	4.5	0.14	0.07	0.09	34.4	31.6	20.8
Canada . . .	3.1	2.6	2.4	0.09	0.05	0.05	39.8	28.8	24.5
United States . .	5.2	3.8	3.7	0.12	0.07	0.07	30.0	22.6	20.8
Australia[1] . . .	4.6	4.2	3.7	0.09	0.07	0.06	36.0	19.6	20.7
New Zealand[2] . .	4.5	3.5	3.5	0.09	0.06	0.06	19.6	39.8	48.3

[1] Excluding full-blood aborigines

[2] Excluding Maoris

TABLE 4

Rheumatic Fever and Chronic Rheumatic Heart Disease Crude Death Rates by Sex per 100,000 population in 1962 —

Annual Epidemiological and Vital Statistics 1962: (World Health Organisation (1965))

Country	Rheumatic Fever			Chronic Rheumatic Heart Disease		
	Total	Male	Female	Total	Male	Female
Scotland . . .	0.2	0.2	0.3	14.6	9.5	19.2
England and Wales. .	0.2	0.3	0.2	15.7	11.2	19.9
Northern Ireland . .	1.0	0.3	1.8	11.8	9.3	14.1
Eire	0.3	0.2	0.4	10.4	10.2	10.6
Canada . . .	0.3	0.3	0.3	7.3	6.8	7.8
United States . .	0.3	0.3	0.3	9.3	8.6	9.9
Australia . . .	0.3	0.3	0.2	6.8	6.0	7.6
New Zealand . .	0.3	0.5	0.2	9.8	9.8	9.7

Morbidity Data

Scottish Hospital In-Patient Statistics

12. In an attempt to assess the amount of rheumatic fever and chronic rheumatic heart disease in Scotland we examined the in-patient statistics for 1963 for each Regional Hospital Board area comparing the number of cases

TABLE 5

Scottish Hospital In-Patient Statistics 1963

Discharges from all Causes;
Rheumatic Fever and Chronic Rheumatic Heart Disease

	Total Discharges from all causes		Rheumatic Fever				Chronic Rheumatic Heart Disease			
	M	F	M		F		M		F	
			No. discharged	Rate per 100,000 of total discharges	No. discharged	Rate per 100,000 of total discharges	No. discharged	Rate per 100,000 of total discharges	No. discharged	Rate per 100,000 of total discharges
Northern	7,984	8,230	8	100	4	49	8	100	9	109
North-Eastern . .	18,649	21,893	14	75	19	87	79	424	165	754
Eastern	21,611	23,594	21	97	27	114	47	217	163	691
South-Eastern . .	45,520	48,843	39	86	69	141	196	431	552	1,130
Western	121,446	126,401	136	112	155	123	360	296	1,306	1,033
TOTAL	215,210	228,961	218	101	274	120	690	321	2,195	959

Congenital and Acquired Heart Disease

Routine School Medical Inspections — (Scotland)

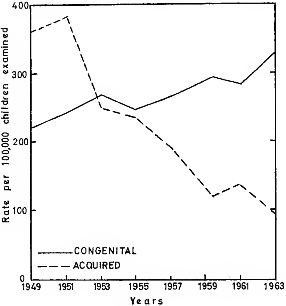

FIGURE 2

discharged from hospitals with the total number of discharges (Table 5). The threefold excess of female cases over males with chronic rheumatic heart disease is in marked contrast with the relatively slight excess in the incidence of rheumatic fever.

Routine School Medical Inspections (Scotland)

13. We obtained from the Scottish Home and Health Department statistical information about the occurrence of acquired and congenital organic heart disease in school children examined at routine medical inspections, which have been carried out at ages 5, 9, 13 and 16 years. The figures for selected years are given in Table 6.

14. An illustration of the trend of the occurrence of the disease is shown in the graph at figure 2. The incidence of acquired organic heart disease, which, in children is almost synonymous with rheumatic heart disease, has fallen steadily to one quarter of its incidence 15 years earlier. By contrast the incidence of congenital heart disease has practically doubled.

TABLE 6

Organic Heart Disease (Acquired and Congenital)

Routine School Medical Inspections (Scotland)
1949, 1954, 1959 and 1964

Year	No. of Children Examined	No. of Cases Found		Rate per 100,000 Examined	
		Acquired	Congenital	Acquired	Congenital
1949	217,337	785	481	361	221
1954	237.260	572	661	241	279
1959	226,539	362	663	160	293
1964	213,005	202	800	95	376

15. In Table 7 below is shown the age and sex breakdown of the number of cases of acquired and congenital organic heart disease revealed at routine school medical inspections in 1959 and 1964.

16. The Table shows a striking reduction in the number of cases of acquired heart disease reported (which in children is almost synonymous with rheumatic heart disease). This contrasts with a considerable increase in cases of congenital heart disease detected over the same period. This increase may reflect better awareness of congenital lesions and improved diagnostic facilities together with increased survival of affected children achieved by modern medical and surgical therapy rather than a real increase in the number of children affected. From the table it would appear that the most significant increase in cases detected is in the five-year-old group.

TABLE 7

Organic Heart Disease (Acquired and Congenital)

Routine School Medical Inspections (Scotland) 1959 and 1964

Year		5-year -olds		9-year -olds		13-year -olds		16-year -olds		Total		Total	Rate per 100,000 examined
		Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls		
1959	No. of cases Acquired	38	40	49	52	75	79	21	8	183	179	362	160
	No. of cases Congenital	180	155	90	99	48	75	9	7	327	336	663	293
	No. examined	41,096	39,266	37,896	36,392	31,577	31,475	4,594	4,243	115,163	111,376	226,539	
1964	No. of cases Acquired	28	34	18	14	28	57	12	11	86	116	202	95
	No. of cases Congenital	278	231	70	59	69	68	13	12	430	370	800	376
	No. examined	44,143	42,343	22,635	21,865	33,437	33,126	8,090	7,366	108,305	104,700	213,005	

TABLE 8

Organic Heart Disease (Acquired)

Routine School Medical Inspections (Scotland)
Edinburgh, Glasgow, Lanarkshire, Scotland
1949, 1959, 1964

Area	Year								
	1949			1959			1964		
	Total cases diagnosed	No. of children examined	Rate per 100,000 examined	Total cases diagnosed	No. of children examined	Rate per 100,000 examined	Total cases diagnosed	No. of children examined	Rate per 100,000 examined
Edinburgh	37	15,410	240	38	16,656	228	8	16,891	47
Glasgow	253	49,466	511	133	51,895	256	52	36,347	143
Lanarkshire	148	26,035	568	136	27,251	499	41	24,784	165
Scotland	785	217,337	361	572	237,260	241	202	213,005	95

17. Comparative figures for acquired heart disease in school children in Edinburgh, Glasgow and the County of Lanark and for Scotland are given in Table 8. These show similar trends, but attention may be drawn to the rates in Glasgow and Lanarkshire which are consistently higher than those for Scotland. A breakdown of the 1964 data according to age and sex is given in Appendix 1.

18. In a regional breakdown (Table 9) of cases found in 1964 of acquired and congenital organic heart disease the highest rates are in the Western Region, presumably reflecting again the high rates in Glasgow and Lanarkshire. The Regions are those of the five Regional Hospital Boards.

TABLE 9

Organic Heart Disease (Acquired and Congenital)

Routine School Medical Inspections — 1964

Region	No. of Children Examined	Cases Found		Rate per 100,000 Children Examined	
		Acquired	Congenital	Acquired	Congenital
Northern	7,679	2	20	26	260
North-Eastern	19,575	9	70	46	358
Eastern	18,840	14	66	74	350
South-Eastern	51,167	42	175	82	342
Western	115,744	135	469	117	405
SCOTLAND	213,005	202	800	95	376

Information from Mass Miniature Radiography Findings

19. The evidence at our disposal from mass miniature radiography findings has given no guide to the incidence of rheumatic disease in children. In the first place the figures relate only to children who have positive Mantoux reactions and secondly the diagnostic value of mass miniature radiography in rheumatic heart disease in children is very limited.

Rheumatic Fever Notifications in Twelve Areas in England

20. The Annual Report of the Chief Medical Officer of the Ministry of Health for the year 1963 gives details of the number of cases of acute rheumatism in children notifiable under the Acute Rheumatism (Amendment) Regulations 1959 (S.I. 1959 No. 213).

TABLE 10

Notification Areas	Registrar-General's Estimate of Child Population 0–14 June, 1963	Total Notified Cases	Acute Rheumatism	Recurrences	* Rate per 100,000
Cornwall	70,800	1	1	—	1.4
Lancashire C.C.	532,800	20	17	1	3.4
Lincolnshire C.C. (Parts of Lindsey)	83,100	3	3	—	3.6
Bristol C.B.	94,500	14	9	—	9.6
Cardiff C.B.	65,200	3	3	—	4.6
Grimsby C. B.	25,100	4	2	1	12.0
Kingston-upon-Hull C.B.	77,900	4	3	—	3.9
Lincoln C.B.	17,900	1	1	—	5.9
Manchester C.B.	155,800	6	6	—	3.9
Newcastle-upon-Tyne C.B,	60,300	3	3	—	5.0
Salford C.B.	36,500	4	4	—	11.1
Sheffield C.B.	101,900	9	7	—	6.9
	1,321,800	72	59	2	4.6

*This table is subscribed from the Report and the rate per 100,000 has been added.

21. In the Annual Reports of the Chief Medical Officer of the Ministry of Health for 1959 to 1963 notified cases of acute rheumatism per 10,000 children under 15 years are given as follows:

1959	1960	1961	1962	1963
1.4	1.4	0.9	0.7	0.5

If the same rates were applied in Scotland the number of children under 15 years, who would have been expected to develop a first attack of acute rheumatism would be:

1959	1960	1961	1962	1963
185	187	120	93	67

Surveys in Dundee and in the Counties of Angus and Lanark

22. We were not satisfied that the evidence obtained by these statistics provided an entirely reliable measure of the extent of rheumatic heart disease in Scotland. As is mentioned in paragraph 6 we decided that an investigation should be carried out to find out the prevalence among school leavers in certain areas. We selected Lanarkshire, Dundee and Angus because they represented both urban and rural areas in different parts of Scotland. The Medical Officers of Health agreed to help in the work of the surveys and we appreciated their ready co-operation.

23. Members of the staff of the Department of Medicine at Queen's College, Dundee agreed to examine the children in Dundee and Angus, while cardiologists in the Cardiology Department of the Royal Infirmary, Glasgow and at Stobhill Hospital, Glasgow agreed to examine the Lanarkshire children. The cardiologists offered themselves to carry out first or screening examination of the children and then to have those suspected of a heart disease brought to a hospital clinic, where a more leisurely and complete examination could be carried out.

24. In order to obtain uniformity of method in the areas the cardiologists taking part had a preliminary meeting and agreed to carry out a short pilot run in the areas. Details of the survey carried out in Lanarkshire and in Dundee and Angus are given respectively in Appendices 2 and 3.

25. In both areas the findings were such that we decided it would not be of value to extend the investigation beyond the sample of children examined in these pilot surveys.

26. These surveys had shown a very high incidence of functional murmurs in children probably related to the circumstances of the examination; the great difficulty of certain diagnosis between functional and organic murmurs in some cases; and the comparative rarity of established organic heart disease in this age group. This experience is parallel to that of American observers, who have published very similar results (see also paragraph 5 of Appendix 3).

Heart Disease in Glasgow School Children

27. Rogen (1952) reported that 917 Glasgow school children were referred to cardiac clinics in the period February 1947 to February 1951, because they were suspected of having heart disease. No evidence of heart disease was found in 486 of those attending, 340 showed evidence of rheumatic heart disease and 91 of congenital heart disease.

28. We are indebted to Dr Rogen for examining his records at our request, for the four years 1960 to 1963 inclusive. Out of 783 children referred because of suspected heart disease he found no evidence of heart disease in 505 children; 59 had rheumatic heart disease, 214 congenital heart disease and 5 had unclassified heart disease.

29. Dr Rogen believes, and we agree, that the reversed ratio in the incidence of congenital and rheumatic heart disease in those two periods is probably due in part to increased specialist skills in the diagnosis of cases of congenital heart disease and in part to improvements in therapy (handling of cardiac failure; surgical treatment; and chemotherapy of intermittent infection) leading to an increased survival rate of cases of congenital heart disease. On the other hand the lower incidence of rheumatic heart disease is probably related to the steady fall in the incidence of rheumatic fever.

Prevention

Environmental and Host Factors

30. We found that there is abundant evidence that rheumatic fever is dependent on antecedent streptococcal infection but that there were still conflicting views about the relative importance of environmental and host factors contributing to this disease. Sir Robert Hutchison said some 40 years ago that acute rheumatism was essentially a working-class disease. Precise figures bearing

out this assertion are available from the work of Leonard Findlay (1931), who in Glasgow in 15 years up to 1930 dealt with 701 cases at the Royal Hospital for Sick Children and refers specifically to the fact that he saw only 15 cases during these years among "really well-to-do families".

31. Although this disease, in its typical form, is now much less common than it was 40 years ago, its association with social classes IV and V is still maintained. Thus, in an analysis of notified cases under 15 years of age in Sheffield during the period 1947-50, the incidence was three times greater among the children of unskilled workers than in those of the professional classes (Hewitt and Stewart, 1952). These workers also concluded that the "risk of rheumatism appears to be greater where opportunities for infection are high; in the town as against the country, the large family as against the small, in children of school age as against children of pre-school age". The most important factors in the Sheffield Study contributing to this social gradient were the number of persons in the household and the degree of family crowding; these findings support the importance of infection since they facilitate both the introduction and spread of haemolytic streptococci in the family and increase the risk of repeated exposure to infection.

32. There is ample corroborative evidence that family crowding is an important element in the aetiology of rheumatic fever. Studies in Birmingham (Thomson, 1928) and in Bristol (Perry and Roberts, 1937) showed a positive correlation between the density per acre or the number of persons per room and the incidence of acute rheumatism. Holmes and Rubbo (1953) showed that in Melbourne school children a higher proportion from low rental areas were streptococcal carriers than those from higher rental areas, with a correspondingly higher incidence of rheumatic fever in the former. Again, Hammon *et al* (1950) found a higher incidence of raised antistreptolysin titres in poor class families, particularly in those with three or more children, and Bywaters (1959) similarly found that the antistreptolysin titres in the cord blood of mothers was correlated with social class but not with parity.

33. Malnutrition is also part of the complex of poverty but the evidence for any active role is much less convincing than for overcrowding. Only two claims have been made for specific dietary deficiencies, that of Glazebrook and Thomson (1942) who found that vitamin C supplements abolished rheumatic fever under epidemic conditions and that of Coburn (1945) who maintained that rheumatic fever in school children was greatly decreased by an egg diet. Neither of these claims has been confirmed elsewhere.

34. Earlier studies have suggested that dampness was a contributory factor but more recent work points to overcrowding as a much more important environmental factor.

35. With regard to the genetic factor Hewitt and Stewart (loc. cit.) make the somewhat ambiguous statement — "There is no evidence in this survey to justify the belief that some families are more prone than others to develop rheumatism: On the other hand blue-eyed children appear to have only one half the liability to acute rheumatism that is suffered by other children and this is evidence of some genetic factor operating".

36. We may conclude that the effect of poverty in the aetiology of rheumatic fever is primarily due to overcrowding which facilitates the introduction and

spread of streptococcal infection. Measures to relieve family crowding should contribute to the reduction of this disease.

Specific Preventive Measures

37. Since the incidence of rheumatic fever is usually higher following outbreaks of streptococcal infection in closed or semi-closed communities, such as schools, residential institutions, army barracks and the like, every effort must be made to limit the spread of such outbreaks as early as possible, e.g. by mass chemoprophylaxis, detection of streptococcal carriers, particularly nasal carriers, and attention to hygiene.

38. It is much less easy to deal with the sporadic cases of rheumatic infection that occur in ordinary communities. Ideally every streptococcal sore throat should be treated actively with a bactericidal drug, since the studies of Rammelkamp and his colleagues (Wannamaker (1954)) with Army personnel indicated that such treatment, by eliminating the infecting streptococcus, would reduce the incidence of subsequent rheumatic infection by some 90 per cent. However, one-third or more of sore throats are not caused by *Streptococcus pyogenes* and, more important perhaps, a considerable proportion of cases of rheumatic fever occur without any clear history of an antecedent sore throat, although there may be evidence of a symptomless infection. For example, in a recent Dutch study (Bots, 1965), it was estimated that approximately 85 per cent. of the cases of streptococcal pharyngitis occurring in a general practice of 4,000 people would have been "missed". Therefore, the treatment of all cases of sore throats seen by the doctor may not help materially in reducing the incidence of primary attacks of rheumatic fever.

39. Any individual who has had rheumatic fever is prone to recurrent attacks when he has further streptococcal sore throats. It is now generally accepted that after a primary attack of rheumatic fever the patient should receive a prophylactic drug during the following five years or until he leaves school to protect him against the risk of further streptococcal infection. At first the sulphonamides were used for this purpose. While effective they have the disadvantage of producing toxic reactions in a small proportion of cases and of inducing sulphonamide resistance in the streptococcus. Penicillin has therefore become the drug of choice for long-term prophylaxis, given either orally as phenoxymethyl penicillin in doses of 250 milligrams per day or as monthly intramuscular injections of the long-acting benzathine penicillin (the usually recommended dose being 1.5 mega units). Trials in different countries of this long-term prophylaxis have shown conclusively that prophylactic penicillin greatly reduces the incidence of recurrence and thereby protects the child against further acute carditis (see Cruickshank and Glynn (1959)). Long term penicillin treatment, however, is not calculated to influence progressive fibrosis (resulting in late development of mitral stenosis or other valvular lesions) in patients who have already sustained cardiac damage in a previous attack.

40. In the revised pamphlet (May 1965) on the "Prevention of Initial Attacks and Recurrences of Rheumatic Fever" issued by the Ministry of Health details of drugs and dosage schedules are given. (These are reproduced in Appendix 4). While supporting the advice given in that pamphlet, we believe that injections of the long-acting benzathine penicillin are more likely to be effective than oral

penicillin both in the treatment of streptococcal sore throat and for the chemoprophylaxis of recurrent rheumatic attacks. The advantages of the injected preparation, we understand, are its greater effectiveness in the elimination of the haemolytic streptococcus, assurance as to the continuity of treatment and cheapness compared with the oral preparation. However, we realise that the disadvantages of the local pain and the possible psychological effects of repeated injections will make this method of treatment distasteful to both doctors and parents. There is also a slightly greater hazard of inducing penicillin sensitivity with injections than with oral therapy.

41. The effective control of rheumatic infection needs co-operative action by the various medical services, supported by the necessary educational programmes. If this is possible we should be able to prevent most rheumatic recurrences under conditions of intermittent exposure to streptococcal infection, prevent many recurrences under conditions of casual exposure and prevent some first attacks of rheumatic fever through effective treatment of recognised streptococcal infection.

Early Ascertainment

42. The School Health Service is in a favourable position to identify children of school age who are at risk to rheumatic heart disease because of medical history or social environment; it is well placed to keep under observation children undergoing preventive therapy or who have heart disease.

43. We understand that a major problem facing the Service is to have effective screening arrangements whereby children requiring special investigation and supervision because of suspected illness, including heart disease, are quickly brought to the notice of the school medical officer. An important part of these arrangements is the use of questionnaires to parents which are sent out in advance of routine inspections, or as part of a screening process whereby children are picked out for special examinations in those areas where the routine medical inspection of some age groups has been replaced by selective examination. We recommend that these questionnaires should contain questions which will provide information about the child's medical history in relation to sore throats, growing pains, rheumatism, heart disease and also to the child's home environment covering such aspects as overcrowding and type of house. Children thought to be at special risk can thus be selected for special examination and supervision. In this regard there should be a close linkage between the Child Welfare and the School Health Services.

Summary of Main Conclusions

Mortality Data

(1) It is apparent that in Scotland between the years 1953 and 1963 there has been a striking reduction in the number of deaths from rheumatic fever in the younger age groups. Further, while the total number of deaths from chronic rheumatic heart disease shows no significant change, there is a marked reduction in the number of deaths in the age groups up to 45. (*Paragraphs 6 to 11*)

Result of Routine School Medical Inspections in 1949 and 1964

(2) The great reduction in the number of cases of acquired heart disease diagnosed at routine school medical inspections between 1949 and 1964 contrasts with a considerable increase in cases of congenital heart disease detected in the same period. This increase may reflect better awareness of congenital lesions and improved diagnostic facilities together with increased survival (of affected children) effected by modern medical and surgical therapy rather than a real increase in the number of children affected. It would appear that the most significant increase in cases detected is in the five-year-old group. (*Paragraphs 13 to 21*)

Preventive Measures

(3) The relationship between an antecedent streptococcal sore throat and the occurrence of primary or recurrent attacks of rheumatic fever is well established. Any environmental factor conducive to the spread of streptococcal infection such as crowding in the house, at school or in training camp should facilitate the occurrence of rheumatic fever. Since family crowding has been shown to be an important element in the aetiology of rheumatic fever, measures to relieve family crowding should contribute to the reduction of the disease. (*Paragraphs 30 to 36*)

(4) Every effort should be made as early as possible to limit the spread of outbreaks of streptococcal infection in schools, residential institutions and barracks, etc., by mass chemoprophylaxis, detection of streptococcal carriers, particularly nasal carriers, and attention to hygiene. (*Paragraphs 30 to 36*).

(5) Ideally every streptococcal sore throat should be treated actively with a bactericidal rather than a bacteriostatic drug. After a primary attack of rheumatic fever the patient should be given a prophylactic drug to protect him against the risk of further streptococcal infection during the following five years or until he leaves school. For this purpose we believe that injections of the long acting benzathine penicillin are more likely to be effective than oral penicillin both in the treatment of streptococcal sore throat and for the chemoprophylaxis of recurrent rheumatic attacks. However, we realise that these injections have disadvantages which will make this method of treatment less acceptable to both doctors and parents. (*Paragraphs 37 to 41*)

(6) Long term penicillin treatment is not calculated to influence progressive fibrosis in patients who have already sustained cardiac damage in a previous attack but will reduce the incidence of further attacks of streptococcal infection and consequent rheumatic relapses with further cardiac damage. (*Paragraphs 37 to 41*)

(7) The effective control of rheumatic infection needs co-operative action by the various medical services supported by the necessary educational programmes. (*Paragraphs 37 to 41*)

(8) We believe that the School Health Service is in a favourable position to identify those children of school age who are at risk to rheumatic heart disease because of medical history or social environment. It is well placed to keep under observation children receiving preventive therapy or who already have sustained rheumatic valvular damage. (*Paragraphs 42 and 43*)

44. We should like to express our appreciation of the services given by the Secretaries, Dr A. Laurie and Miss M. J. Yeats, for their assistance in our work and for the part they played in the preparation of this report.

ROBERT CRUICKSHANK
Chairman

FEBRUARY, 1966

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Appendix 1

Organic Heart Disease (Acquired)
Routine School Medical Inspections
Edinburgh, Glasgow, Lanarkshire, Scotland

Age and Sex Breakdown (1964)

Area	No. Examined		5-year-olds		9-year-olds		13-year-olds		16-year-olds		Total			Rate per 100,000
			Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Both Sexes	
Edinburgh	16,891	No. of cases	3	2	3	—	—	—	—	—	6	2	8	47
		No. examined	3,231	3,002	2,571	2,524	2,223	2,202	573	565	8,598	8,293	16,891	
Glasgow	36,347	No. of cases	5	7	—	—	9	28	1	2	15	37	52	143
		No. examined	9,485	9,249	—	—	7,511	7,433	1,541	1,128	18,537	17,810	36,347	
Lanarkshire	24,784	No. of cases	2	4	7	7	11	7	1	2	21	20	41	165
		No. examined	4,322	4,273	4,505	4,540	3,414	2,934	410	386	12,651	12,133	24,784	
Scotland	213,005	No. of cases	28	34	18	14	28	57	12	11	86	116	202	95
		No. examined	44,143	42,343	22,635	21,865	33,437	33,126	8,090	7,366	108,305	104,700	213,005	

Appendix 2

Survey in Western Region by:

Dr A. S. Rogen, M.D., F.R.F.P.S., F.R.C.S.,
Consultant Physician,
Western Regional Hospital Board.

Dr R. Fife, M.D., CH.B., F.R.F.P.S., M.R.C.P.,
Consultant Cardiologist,
Western Regional Hospital Board.

Dr R. S. Walker, M.D., M.R.C.P.ED., F.R.F.P.S.,
Consultant Physician,
Western Regional Hospital Board.

Dr T. D. V. Lawrie, B.SC., M.D., M.R.C.P.,
Consultant Cardiologist,
Western Regional Hospital Board.

1. Two surveys were carried out in Lanarkshire in late 1963 and early 1964. Schools in Rutherglen, Coatbridge, Airdrie, Larkhall, Carluke, Strathaven, East Kilbride and Wishaw were visited. Twenty-five children were requested to attend for medical examination at each school. In each survey there was a 93% attendance.

2. The facilities offered by the headmaster of each school were very good. It was evident that the Medical Officer of Health and his staff had organised these examinations very carefully.

3. The examiners were impressed by the high incidence of innocent systolic murmurs, many of which were associated with forcible cardiac action, especially amongst girls.

4. Seven cases (4%) were requested to attend hospital for further assessment. At hospital these cases had a second clinical examination by a cardiologist, other than the one who had referred the case, together with screening of heart, electrocardiography, phonocardiography and haemoglobin estimation.

5. Of the seven patients who were recalled six had a loud systolic murmur at the pulmonic area and one had a systolic murmur at the apex of doubtful significance. After further investigation it was not possible to say whether these cases had a minor congenital defect (murmur at the pulmonic area raising the possibility of A.S.D.) or rheumatic heart disease (mitral V.D.H.).

6. No obvious case of rheumatic heart disease was observed in this group, there being only 1 doubtful, early mitral valve lesion. This means that the incidence of rheumatic heart disease in this age group of school children in Lanarkshire is less than 0.5% or that the sampling of cases was inadequate. It seems unlikely, however, that the incidence of rheumatic heart disease is much higher, even if children of the same age group attending special schools, were included.

7. In view of the labour involved in these surveys together with the results obtained (in terms of incidence of rheumatic heart disease), it does not seem worthwhile to extend these surveys.

Appendix 3

Survey in Eastern Region by:

Dr K. G. Lowe, M.D., F.R.C.P., F.R.C.P.ED.,
Consultant Physician,
Eastern Regional Hospital Board.

Dr D. Emslie-Smith, M.D., F.R.C.P.ED., M.R.C.P.,
Senior Lecturer in Medicine —
Honorary Consultant in Clinical Medicine

Dr H. Watson, M.D., F.R.C.P.ED., M.R.C.P.,
Consultant Cardiologist,
Eastern Regional Hospital Board.

1. A survey was carried out in Angus in 1963. Children from a country area school (Newtyle school), from a town area school (Linlathen school) and from a country school (Arbroath Academy) were selected. The number of children examined was 110. (see paragraph 8).

2. Thanks to the ready co-operation of the Medical Officers of Health and their colleagues in the School Health Service on the one hand and to the co-operation of the Headmasters and teaching staff of the various schools facilities throughout were excellent. All three observers remarked on this. This had important repercussions, first in enabling a large number of children to be examined in the minimum time, and secondly through provision of a silent environment in which critical auscultation could be practised. Clearly, the conditions were much better than School Medical Officers normally experience in their routine school examinations.

3. The number of *possible* cases of heart disease was small, the percentage of those examined being only 6.3%. It is likely that on detailed investigation, including X-ray, ECG. etc., a large proportion of these suspected cases would have been transferred to the "innocent" group.

4. The high incidence of innocent or functional murmurs is especially noteworthy. They were particularly common in girls, as seen in the experience of observer B, where 28 out of 30 children displayed such murmurs. Under the conditions of such an examination with the attendant excitement and some apprehension, young people, and particularly girls at puberty, develop a hyperdynamic state with bounding fast pulses and over-active hearts. Under these circumstances functional murmurs are the rule rather than the exception.

5. This experience is parallel to that of American observers, who have published very similar results; of large numbers of children examined a very small percentage had signs of clear-cut or suspected heart disease, and a very large proportion had functional murmurs. The differentiation of mild grades of organic heart disease from functional murmurs is exceedingly difficult, even after full investigation under ideal conditions in hospital.

6. It is concluded that a survey of this type does not yield results commensurate with the time, labour and inconvenience expended.

A survey lays a considerable burden on the Medical Officers of Health and their colleagues in the School Health Service, on the Headmasters and teachers in the schools visited, and on the children and their parents who become exercised and apprehensive.

7. It is further clear that in the sample examined overt cases of rheumatic and congenital heart disease are alike uncommon. There would appear to be no hidden reservoir of undetected cardiac disease in this sample of school-leavers.

8. The results of the survey were as follows:

School	Total Examined	Nil abnormal discovered	Innocent murmurs	Recall as Suspect VDH
A	31	18	10	2
B	30	2	28	1 (?VSD)
C	49	22	23	4
Totals	110	42	61	7

Appendix 4

Extract from the pamphlet "Prevention of Initial Attacks and Recurrences of Rheumatic Fever"

(Revised May, 1965)

Prepared by The Standing Medical Advisory Committee
for the Central Health Services Council and the
Minister of Health

Paragraph 5 — Dosage

Although the details of dosage for an individual patient must be decided by the doctor in charge it may be useful to quote the following in relation to the various circumstances outlined above:

(a) *Bactericidal Dosage*† to combat streptococcal infection likely to cause first attacks of rheumatic fever (4(a) above) or recurrences in an individual who has had rheumatic fever (4(c)(ii) above):

> Initially benzyl penicillin 2 million units I.M. followed by phenoxymethylpenicillin tablets 250 mgs. t.i.d. *or* benzyl penicillin tablets B.P. 500,000 units t.i.d. for a total period of ten days. In patients sensitive to penicillin an antibiotic such as erythromycin may be used instead, but *not* sulphonamides, which are quite ineffective.

(b) *Bactericidal Dosage*† to ensure the blood levels necessary to minimise the risk of endocarditis in individuals with rheumatic heart disease about to undergo dental extraction or operation such as tonsillectomy, (4(c)(iii) above):

> One hour before dental extraction or operation 300,000 units of benzyl penicillin and 300,000 units of procaine benzyl penicillin intramuscularly; then 6-12 hours after extraction another 300,000 units of procaine benzyl penicillin intramuscularly. This may be considered sufficient but if in doubt it could be followed by 250 mg. of phenoxymethylpenicillin tablets (or 500,000 units of benzyl penicillin tablets B.P.) by mouth six hourly for two days.

In individuals with rheumatic heart disease who are already on penicillin prophylaxis there is a risk in operations such as those mentioned above of infection caused by a penicillin resistant organism. In these circumstances the question of cover by tetracycline, erythromycin or vancomycin preparations should be considered in the light of expert local advice.

(c) *Continuous Prophylaxis Dosage.* Under ordinary circumstances streptococcal infection leading to recurrences may be prevented in individuals who have had rheumatic fever (4(b) above) by either:

- (i) Benzyl penicillin Tablets B.P. 200,000 units twice daily by mouth, or
- (ii) Phenoxymethylpenicillin Tablets (Penicillin V-tablets) 125 mg. twice daily by mouth, or
- (iii) Although oral treatment is recommended as a routine there may be exceptional circumstances, such as persistent or recurrent vomiting or when there is reason to doubt that the tablets will be taken regularly, which necessitates alternative measures. Monthly injections of benzathine penicillin 1.5 mega units (5 ml.) will provide satisfactory prophylaxis in such cases.

In the unlikely event of the development of untoward reactions to penicillin such as urticaria, angioneurotic oedema, fever, joint pain and swelling, which may occur during the first three months, the Committee recommended the substitution of a sulphonamide. Sulphadimidine in doses of 0.5 to 1.0 gm. daily by mouth may be given for this purpose.

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† These preparations and dosages have been agreed by the Rheumatic Fever Committee of the Royal College of Physicians of London as being more suitable in the light of recent experience than those recommended in their Report of 1957.

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